Answers to Anonymous Referee #1, Nan Lu, 24 SEP 2013

We thank the anonymous referee for his comments. In this reply we address the suggestions for revisions point by point.

Anonymous Referee #1

The MS deals with an interesting issue for soil organic carbon change following afforestation at Northern Shan'xi Province in middle Loess Plateau areas. I think this article has the potential to be an interesting addition to the literature. But still needs improve huge.

<Reply> Thanks for the general positive evaluation of our manuscript.

My comments as follow:

1. The Loess Plateau is the largest continuous area of loess in the world (about 70% of global loess distribution) covering an area of 640 000 km2. However, the samplings were selected from six sites where were concentrated at Northern Shan'xi Province. Because the variety of climate and topography among the huge area, the limited samplings from a concentrated area can not illustrate the aim of the title. If you want to publish your paper, the title should be changed.

<Reply> Thanks for this suggestion. The title was a little broad. We changed our title to be more specific: "Soil organic carbon dynamics of Black Locust plantations in the middle Loess Plateau area of China".

2. Because there are many tree (and shrub) species been planted in Loess Plateau, monitor one vegetation (Robinia pseudoacacia) plantation is not suitable to illustrate the result of afforestation. If you want to publish your paper, the title should be changed, too. The follow reference may be useful to understand the afforestation in the study site:

(1) Shixiong Cao, Li Chen, Zhande Liu, Guosheng Wang. A new tree-planting technique to improve tree survival and growth on steep and arid land in the Loess Plateau of China. Journal of Arid Environments 2008, 72, 1374–1382.

(2) Shixiong Cao, Li Chen, Zhande Liu. Impact of three soil types on afforestation in China's Loess Plateau. Landscape and Urban Planning, 2007, 83, 208-217.

<Reply> Thanks for this suggestion and the references. The title was a little broad. We were not to illustrate the result of afforestation in the entire region. The study is limited to one species, i.e., Robinia pseudoacacia, which is one of the most typical and commonly used species in afforestation in the Loess Plateau. We changed the title to be more specific as stated above. Paper#2 was cited in the revised paper in discussing the uncertainties of the study.

3. "Water stress is the main factor that limits seedling establishment in arid area". And the results illustrate "The initial SOC stocks were significantly higher at the wetter (1 and 2) than the drier (3, 4, 5, and 6) sites ($p < 0.01$) (Figs. 6–8)." It implies there is a site SOC may decline continues after afforestation where the precipitation is a little.

<Reply> In our study, “The initial SOC stocks were significantly higher at the wetter (1 and 2) than the drier (3, 4, 5, and 6) sites ($p < 0.01$)”. It is in agreement with the global distribution of SOC increases with increasing precipitation (Jobbagy and Jackson, 2000). However, it is not necessarily true to deduce the SOC dynamics at one site based on the differences in the initial SOC values between the wetter and the drier sites. This is because land use history is another key factor for initial SOC stock besides climate (or water availability). A sentence was added to clarify this in the revised paper (Line 199-200): “The differences in the initial SOC between the wetter and the drier sites resulted from both the climate and the land use history (Table 1)”. In our study, the higher initial SOC stocks at sites 1 and 2 (wetter sites) compared to sites 3, 4, 5, and 6 (drier sites) was partly caused by the development of secondary forest in the 1860s due to emigration at the wetter sites, and there was no natural forest recovery in recent times at the drier sites.

In our study, we drew the conclusion that afforestation on former arable land increased SOC based on the data of 30 years. The result could be different if the time length is longer (>25 or 30 years) as soil water may be a limiting factor. The longer-term dynamics of the SOC will need longer-term observation and further studies. This has been discussed in the paper.

There is some different sounds about afforestation in arid area (see follow reference). I think the tree establishment seems useful for wood product, greenway conservation, and so on. Please download the follow references and improve you discussion.

(3) Shixiong Cao, Li Chen, David Shankman, Chunmei Wang, Xiongbin Wang, and Hong Zhang. Excessive Reliance on Afforestation in China’s Arid and Semiarid Regions: Lessons in Ecological Restoration. Earth-Science Reviews 2011, 104, 240-245

(4) Chengli Xu, Huihai Ye, Shixiong Cao. Constructing China’s Greenways Naturally. Ecological Engineering 2011, 37, 401-406

(5) Shixiong Cao, Guosheng Wang, Li Chen. Questionable value of planting thirsty trees in dry regions. Nature, 2010, 465, 31-31

(6) Shixiong Cao, Li Chen, Xinxiao Yu. Impact of China’s Grain for Green Project on the landscape of vulnerable arid and semiarid agricultural regions: a case study in northern Shaanxi Province. Journal of Applied Ecology, 2009, 46, 536-543.

(7) Jiang et al. Vegetation of the Chinese Loess Plateau since the Last Glacial Maximum and its implications for afforestation. Journal of Applied Ecology, 2012

(8) Shixiong Cao. Why large-scale afforestation efforts in China have failed to solve the desertification problem. Environmental Science and Technology, 2008, 42(5)1826-1831

(9) Shixiong Cao, Tao Tian, Li Chen, Xiaobin Dong, Xinxiao Yu, Guosheng Wang. Damage Caused to the Environment by Refforestation policy in Arid and Semiarid Areas of China. Ambio 2010, 39(4), 279-283

(10) Yafeng Wang, Shixiong Cao. Carbon Sequestration may have Negative Impacts on Ecosystem Health. Environmental Science and Technology 2011, 45, 1759-1760

(11) Shixiong Cao, Ge Sun, Zhiqiang Zhang, Liding Chen, Qi Feng, Bojie Fu, Steve McNulty, David Shankman, Jianwu Tang, Yanhui Wang, Xiaohua Wei. Greening China Naturally. Ambio 2011, 40, 828–831

(12) Shixiong Cao. Impact of China's large-scale ecological restoration program on the environment and society: achievements, problems, synthesis, and applications. Critical Reviews in Environmental Science and Technology 2011, 41, 317–335

The SOC stock is found to increase after a few years of afforestation on former arable lands in many studies. There are contrasting findings that afforestation can have negative or no effects on SOC. This may relate to different time scale (i.e., year after afforestation), site disturbance, and initial SOC stock among the studies (Smal and Olszewska, 2008). This point was added in the discussion (Line 284-287). Another issue that may need clarification is vegetation conversion type. It was found that afforestation on arable lands is not as good as converting arable lands into grasslands or shrublands in soil carbon sequestration. Conversion from pasture or native forest to tree plantations can even decrease SOC (Guo and Gifford, 2002). Therefore, the "different sounds" indicated by the reviewer may also relate to different vegetation conversion type (as discussed in some of the suggested references by the reviewer). It only referred to tree afforestation on former arable land in our study.

Thanks for providing the references which contain useful information. We agree with the reviewer that afforestation in arid areas may lead to problems such as water shortage. However, the evaluation of the overall effects of afforestation or the sustainability of the plantations is not the main objective of this paper. We only tried to understand the temporal dynamics of soil organic carbon (SOC) and its controlling factors. Therefore, we just mentioned the issue of sustainability and briefly discussed it. We did not intend to write too much about the ecological effects of afforestation such as wood production and greenway conservation, which is beyond the scope of this paper. To make the discussion focused and concise, we cited the most relevant references suggested above (paper #2 and #5).

Guo, L.B., Gifford, R.M.: Soil carbon stocks and land use change, Global Change Bio., 8, 345-360, 2002.

Jobbagy, E.G., Jackson, R.B. The vertical distribution of soil organic carbon and its relation to climate and vegetation. Ecological Applications, 10(2), 423-436, 2000

Smal, H., Olszewska, M. The effect of afforestation with Scots pine (Pinus silvestris L.) of sandy post-arable soils on their selected properties. II. Reaction, carbon, nitrogen and phosphorus, Plant and Soil, 305, 171-187, 2008.

4. In my opinion, the discussion structure should different from results section and focus on the mechanism (the relation between your data and why you find different result from others'). Therefore, there are huge work wait you do.

<Reply> Thanks for this suggestions. But in order to make the discussion more focused, we keep the same discussion structure. The discussion was developed following the major findings of the study but not identical with the result section. We enriched the discussion about the reasons of inconsistent results of soil carbon dynamics following afforestation among different studies, as replied to the third comment.